

Mine Safety and Health Admin., Labor

§ 18.31

surfaces, within the enclosure shall be as follows:

MINIMUM CLEARANCES BETWEEN UNINSULATED SURFACES

Phase-to-Phase Voltage (rms)	Clearances (inches)	
	Phase-to-Phase	Phase-to-Ground or Control Circuit
0 to 250	0.25	0.25
251 to 600	0.28	0.25
601 to 1000	0.61	0.25
1001 to 2400	1.4	0.6
2401 to 4160	3.0	1.4

[57 FR 61209, Dec. 23, 1992]

§ 18.25 Combustible gases from insulating material.

(a) Insulating materials that give off flammable or explosive gases when decomposed electrically shall not be used within enclosures where the materials are subjected to destructive electrical action.

(b) Parts coated or impregnated with insulating materials shall be heat-treated to remove any combustible solvent(s) before assembly in an explosion-proof enclosure. Air-drying insulating materials are excepted.

§ 18.26 Static electricity.

Nonmetallic rotating parts, such as belts and fans, shall be provided with a means to prevent an accumulation of static electricity.

§ 18.27 Gaskets.

A gasket(s) shall not be used between any two surfaces forming a flame-arresting path except as follows:

(a) A gasket of lead, elastomer, or equivalent will be acceptable provided the gasket does not interfere with an acceptable metal-to-metal joint.

(b) A lead gasket(s) or equivalent will be acceptable between glass and a hard metal to form all or a part of a flame-arresting path.

§ 18.28 Devices for pressure relief, ventilation, or drainage.

(a) Devices for installation on explosion-proof enclosures to relieve pressure, ventilate, or drain will be acceptable provided the length of the flame-arresting path and the clearances or

size of holes in perforated metal will prevent discharge of flame in explosion tests.

(b) Devices for pressure relief, ventilation, or drainage shall be constructed of materials that resist corrosion and distortion, and be so designed that they can be cleaned readily. Provision shall be made for secure attachment of such devices.

(c) Devices for pressure relief, ventilation, or drainage will be acceptable for application only on enclosures with which they are explosion tested.

§ 18.29 Access openings and covers, including unused lead-entrance holes.

(a) Access openings in explosion-proof enclosures will be permitted only where necessary for maintenance of internal parts such as motor brushes and fuses.

(b) Covers for access openings shall meet the same requirements as any other part of an enclosure except that threaded covers shall be secured against loosening, preferably with screws having heads requiring a special tool. (See Figure 1 in Appendix II.)

(c) Holes in enclosures that are provided for lead entrances but which are not in use shall be closed with metal plugs secured by spot welding, brazing, or equivalent. (See Figure 10 in Appendix II.)

§ 18.30 Windows and lenses.

(a) MSHA may waive testing of materials for windows or lenses except headlight lenses. When tested, material for windows or lenses shall meet the test requirements prescribed in § 18.66 and shall be sealed in place or provided with flange joints in accordance with § 18.31.

(b) Windows or lenses shall be protected from mechanical damage by structural design, location, or guarding. Windows or lenses, other than headlight lenses, having an exposed area greater than 8 square inches, shall be provided with guarding or equivalent.

§ 18.31 Enclosures—joints and fastenings.

(a) Explosion-proof enclosures:

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(1) Cast or welded enclosures shall be designed to withstand a minimum internal pressure of 150 pounds per square inch (gage). Castings shall be free from blowholes.

(2) Welded joints forming an enclosure shall have continuous gas-tight welds. All welds shall be made in accordance with American Welding Society standards.

(3) External rotating parts shall not be constructed of aluminum alloys containing more than 0.6 percent magnesium.

(4) MSHA reserves the right to require the applicant to conduct static-pressure tests on each enclosure when MSHA determines that the particular design will not permit complete visual inspection or when the joint(s) forming

an enclosure is welded on one side only (see § 18.67).

(5) Threaded covers and mating parts shall be designed with Class 1A and 1B (coarse, loose-fitting) threads. The flame-arresting path of threaded joints shall conform to the requirements of paragraph (a)(6) of this section.

(6) Enclosure requirements shall be based on the internal volumes of the empty enclosure. The internal volume is the volume remaining after deducting the volume of any part that is essential in maintaining the explosion-proof integrity of the enclosure or necessary for the operation. Essential parts include the parts that constitute the flame-arresting path and those necessary to secure parts that constitute a flame-arresting path. Enclosures shall meet the following requirements:

EXPLOSION-PROOF REQUIREMENTS BASED ON VOLUME

	Volume of empty enclosure		
	Less than 45 cu. in.	45 to 124 cu. in. inclusive	More than 124 cu. in.
Minimum thickness of material for walls ¹	1/8"	3/16"	1/4"
Minimum thickness of material for flanges and covers	2 1/4"	3 3/8"	3 1/2"
Minimum width of joint; all in one plane ⁴	1/2"	3/4"	1"
Maximum clearance; joint all in one plane	0.002"	0.003"	0.004"
Minimum width of joint, portions of which are in different planes; cylinders or equivalent ^{4,5}	3/8"	5/8"	3/4"
Maximum clearances; joint in two or more planes, cylinders or equivalent:			
(a) Portion perpendicular to plane ⁶	0.008"	0.008"	0.008"
(b) Plane portion	0.006"	0.006"	0.006"
Maximum bolt ^{7,8} spacing; joints all in one plane	(¹⁶)	(¹⁶)	(¹⁶)
Maximum bolt spacing; joints, portions of which are in different planes	(⁹)	(⁹)	(⁹)
Minimum diameter of bolt (without regard to type of joint)	1/4"	1/4"	3/8"
Minimum thread engagement ¹⁰	1/4"	1/4"	3/8"
Maximum diametrical clearance between bolt body and unthreaded holes through which it passes ^{8,11,12}	1/64"	1/32"	1/16"
Minimum distance from interior of enclosure to the edge of a bolt hole: ^{8,13}			
Joint—minimum width 1"			14 7/16"
Joint—less than 1" wide	1/8"	3/16"	
Cylindrical joints			
Shaft centered by ball or roller bearings:			
Minimum length of flame-arresting path	1/2"	3/4"	1"
Maximum diametrical clearance	0.020"	0.025"	0.030"
Other cylindrical joints: ¹⁵			
Minimum length of flame-arresting path	1/2"	3/4"	1"
Maximum diametrical clearance	0.006"	0.008"	0.010"

¹ This is the minimal nominal dimension when applied to standard steel plate.

² 1/32 inch less is allowable for machining rolled plate.

³ 1/16 inch less is allowable for machining rolled plate.

⁴ The widths of any grooves, such as grooves for holding oil seals or O-rings, shall be deducted in measuring the widths of flame-arresting paths.

⁵ If only two planes are involved, neither portion of a joint shall be less than 1/8 inch wide, unless the wider portion conforms to the same requirements as those for a joint that is all in one plane. If more than two planes are involved (as in labyrinths or tongue-and-groove joints) the combined lengths of those portions having prescribed clearances are considered.

⁶ The allowable diametrical clearance is 0.008 inch when the portion perpendicular to the plane portion is 1/4 inch or greater in length. If the perpendicular portion is more than 1/8 inch but less than 1/4 inch wide, the diametrical clearance shall not exceed 0.006 inch.

⁷ Where the term "bolt" is used, it refers to a machine bolt or a cap screw, and for either of these studs may be substituted provided the studs, bottom in blind holes, are completely welded in place, or the bottom of the hole is closed with a plug secured by weld or braze. Bolts shall be provided at all corners.

⁸ The requirements as to diametrical clearance around the bolt and minimum distance from the bolt hole to the inside of the explosion-proof enclosure apply to steel dowel pins. In addition, when such pins are used, the spacing between centers of the bolts on either side of the pin shall not exceed 5 inches.

⁹ Adequacy of bolt spacing will be judged on the basis of size and configuration of the enclosure, strength of materials, and explosion test results.

¹⁰ In general, minimum thread engagement shall be equal to or greater than the diameter of the bolt specified.

¹¹ Threaded holes for fastening bolts shall be machined to remove burrs or projections that affect planarity of a surface forming a flame-arresting path.

¹² This maximum clearance applies only when the bolt is located within the flamepath.

¹³ The edge of the bolt hole shall include the edge of any machining done to the bolt hole, such as chamfering.

¹⁴ Less than $\frac{7}{16}$ " ($\frac{1}{4}$ " minimum) will be acceptable provided the diametrical clearance for fastening bolts does not exceed $\frac{1}{32}$ ".

¹⁵ Shafts or operating rods through journal bearings shall be at least $\frac{1}{4}$ " in diameter. The length of fit shall not be reduced when a push button is depressed. Operating rods shall have a shoulder or head on the portion inside the enclosure. Essential parts riveted or bolted to the inside portion are acceptable in lieu of a head or shoulder, but cotter pins and similar devices shall not be used.

¹⁶ 6" with a minimum of 4 bolts.

(7) O-rings, if used in a flame-arresting path, shall meet the following:

(i) When the flame-arresting path is in one plane, the o-ring shall be located at least one-half the acceptable flame-arresting path length specified in paragraph (a)(6) of this section within the outside edge of the path (see figure J-2 in the appendix to subpart J of part 7 of this chapter).

(ii) When the flame-arresting path is one of the plane-cylindrical type (step joint), the o-ring shall be located at least $\frac{1}{2}$ inch within the outer edge of the plane portion (see figure J-3 in the appendix to subpart J of part 7 of this chapter), or at the junction of the plane and cylindrical portion of the joint (see figure J-4 in the appendix to subpart J of part 7 of this chapter); or in the cylindrical portion (see figure J-5 in the appendix to subpart J of part 7 of this chapter).

(8) Mating parts comprising a pressed fit shall result in a minimum interference of 0.001 inch between the parts. The minimum length of the pressed fit shall be equal to the minimum thickness requirement of paragraph (a)(6) of this section for the material in which the fit is made.

(b) Enclosures for potted components: Enclosures shall be rugged and constructed with materials having 75 percent, or greater, of the thickness and flange width specified in paragraph (a) of this section. These enclosures shall be provided with means for attaching hose conduit, unless energy carried by the cable is intrinsically safe.

(c) No assembly will be approved that requires the opening of an explosion-proof enclosure to operate a switch,

rheostat, or other device during normal operation of a machine.

[33 FR 4660, Mar. 19, 1968, as amended at 57 FR 61209, Dec. 23, 1992]

§ 18.32 Fastenings—additional requirements.

(a) Bolts, screws, or studs shall be used for fastening adjoining parts to prevent the escape of flame from an enclosure. Hinge pins or clamps will be acceptable for this purpose provided MSHA determines them to be equally effective.

(b) Lockwashers shall be provided for all bolts, screws, and studs that secure parts of explosion-proof enclosures. Special fastenings designed to prevent loosening will be acceptable in lieu of lockwashers, provided MSHA determines them to be equally effective.

(c) Fastenings shall be as uniform in size as practicable to preclude improper assembly.

(d) Holes for fastenings shall not penetrate to the interior of an explosion-proof enclosure, except as provided in paragraph (a)(9) of § 18.34, and shall be threaded to insure that a specified bolt or screw will not bottom even if its lockwasher is omitted.

(e) A minimum of $\frac{1}{8}$ -inch of stock shall be left at the center of the bottom of each hole drilled for fastenings.

(f) Fastenings used for joints on explosion-proof enclosures shall not be used for attaching nonessential parts or for making electrical connections.

(g) The acceptable sizes for and spacings of fastenings shall be determined by the size of the enclosure, as indicated in § 18.31.

(h) MSHA reserves the right to conduct explosion tests with standard bolts, nuts, cap screws, or studs substituted for any special high-tensile